On opening a number of specimens, it was found that all those with a large anal fin were males, while those in which that organ was small were females. The females are, however, to be distinguished from the males by another character, namely the much larger size of the urogenital pore, which is situated immediately behind the anus.

XXII.—*On the Amylaceous Globules of the* Florideæ *and* Corallineæ. By M. van Tieghem*.

Kützing first indicated† the existence in the cells of certain Florideæ of amyloid grains, sometimes endowed with a concentric structure; but in assimilating them to the protoplasmic globules of the green and olive Algæ, in including under the general name of *cellular globules* or *gonidia* the whole of the intracellular formations of the Algæ, however dissimilar they may be, and in ascribing to them, as is implied by this name, a reproductive faculty, the illustrious algologist seems to me to have misunderstood their nature and function. M. Nägeli, also, in his great work on starch-grains‡, hesitates to pronounce an opinion as to the existence of starch in the Florideæ. His own observations, indeed, showed him, in *Cystoclonium purpurascens*, Kütz., some globules to which iodine communicates a coloration varying from red to brown and violet; but he took them for slightly amylaceous parietal grains of protoplasm, and he remained so uncertain upon this point as to declare, in another part of his memoir (p. 382), that starch-grains are wanting in the Florideæ, and finally to leave to future investigations the care of deciding whether these Algæ do possess starch, and of what kind it is. It is this point that I have undertaken to clear up by a series of observations, of which I have the honour to present the Academy with the first results.

For the sake of clearness I shall take as an example *Halopithys pinastroides*, Kutz., which is found in abundance on our coasts. In the cylindrical and much branched frond of this Floridean, the thickened joints of the axis contain only a finely granular liquid; the joints of the five siphons, on the contrary, and the cortical cells are filled with transparent globules, which are colourless in the interior tissue and of a rosy tint in the peripheral zone, although readily deprived of their colour by alcohol; these are scattered in the liquid which bathes the sections, forming therein white streaks. Their most general

* Translated from the Comptes Rendus, Nov. 6, 1865, pp. 804–807.
† Phycologia generalis, p. 40.
‡ Pflanzenphysiologische Untersuchungen: Die Stärke-Körner, 1858.

form is spherical or ovoid; sometimes they are flattened and discoidal or lenticular in form, sometimes irregular. They are formed by a very distinct colourless or rose-coloured membrane, filled with solid greyish contents, most frequently without any central space, but sometimes with a cavity in the centre, which it is not unusual to see divided into several compartments. The full globules are of two kinds: some, and by far the greater number, have a circular outline and are simple; their contents, apparently homogeneous, are formed of very delicate concentric zones, and give a very clear black cross in the polarizing apparatus; the others, variable in form and aspect, are composite, and show a system of concentric layers and a black cross in each of their compartments, when these are sufficiently large.

The very variable dimensions of these globules is in relation to their degree of development: the ordinary diameter of the well-developed grains is from 0·013–0·015 millimetre; the maximum observed was 0·025 millimetre. Iodine gives them a *reddish-yellow* colour. This tint persists upon all the globules whatever be the quantity of tincture of iodine employed; but when we renew the liquid which bathes the grains in proportion as it evaporates, replacing it alternately by a drop of tincture of of iodine and a drop of water, at the edges of the covering glass, where the osmotic movements produced by an alternate disiccation and humectation with liquids of different densities are most active, we see the globules become altered in a remarkable manner at the same time that their colour changes. Sometimes there appears at the centre a small circular space, which enlarges by degrees, the layers becoming dissolved successively from the centre to the periphery, at the same time that the globule enlarges and becomes discoidal; it is reduced at last to a membrane, which becomes more and more delicate, entire or irregularly torn, and as the granule becomes empty its tint passes to pure violet. In other cases the solution commences by a circle of small holes, which increase radially, remaining separated by solid rays; the centre is at the same time hollowed, and the outer membrane, being unable to yield equally to the inflation, becomes undulated; the globule is then of a fine violet, and presents the aspect of a wheel, of which the nave, the spokes, and the undulated felly are of a deep violet, and the intervals of a lighter tint. In the composite globules, formed of compartments arranged in a circle round a central chamber, the contents of each compartment become dissolved by degrees, the granule swells, becomes of a fine violet colour, and presents the radiated appearance which I have just described, with still more distinctness. This disorganization of the granule with blue coloration may, however, be produced rapidly.

If iodized water be brought into contact with globules placed in alcohol, we see a certain number of the granules situated on the line of meeting of the two liquids suddenly burst, and throw out around them their contents, reduced to the form of very small granules, which become *blue*, whilst the torn membrane is of a pale violet colour.

When heated in water to near 158° Fahr. the globules swell, become partially dissolved, and at the same time acquire a fine violet colour. A drop of sulphuric or hydrochloric acid immediately gives a violet or blue tint to the granules which have been reddened by iodine, but at the same time dissolves them partially, swells them up, and tears them. Potash also dissolves them. Hypochlorite of lime alters them rapidly; in twenty-four hours there remain of most of the granules only the outermost layers isolated from each other; in thirty-six hours all has disappeared. Acetic acid and ammonia have no action upon them.

Thus these globules present all the characters of starch in their form, structure, and optical properties, and in the action exerted upon them by hot water, acids, and alkalies; but they differ from amylaceous grains as these are defined, by their acquiring a red colour with iodine. However, they are easily converted into common starch under the ordinary influences which I have just described, but with the condition that they become disorganized and partially dissolved. This difference, which is not sufficient to warrant the employment of a new name, leads to the supposition that we have to do with a hydrocarbonated principle isomeric with cellulose and starch, but intermediate between them by its cohesion.

After the details into which I have entered with regard to *Halopithys pinastroides*, Kütz., I can only say a few words of the starch-grains of other Florideæ; but I must make special mention of the *Polysiphoniæ*, because the amylaceous formation in them presents a new character, which, indeed, occurs very frequently elsewhere, but less evidently. In *Polysiphonia nigrescens*, Grev., which I shall take as an example, the joints of the axis never contain anything but a finely granular liquid; the flattened cells of the siphons, on the contrary, and the cortical cells each contain a coherent mass of spherical globules, which entirely fills them. These globules, the diameter of which is pretty uniformly 0·007 millim., do not scatter themselves in the liquid which bathes the sections, but the entire masses issue in their cells. By applying pressure to them we may succeed in breaking them up into several fragments; but their elements, which have a strong mutual adherence, do not separate; when their margin is carefully examined, they are seen to be surrounded by a continuous membrane, which is rendered yellow by iodine;

a drop of sulphuric acid renders the globules violet, whilst the envelope remains yellow; the prolonged action of the acid dissolves the granules, and all that remains of the mass is a yellow reticulated membrane, with circular or polygonal meshes, produced by a fold which the membrane sends between the globules of the peripheral layer. A reticulated envelope of the same kind exists also in *Halopithys*; but, the elements not having a strong mutual adherence, it is torn under the knife, and is only met with here and there in fragments carried away by the peripheral globules, which are inserted upon it by small pedicels. I have ascertained its presence in most of the species that I have investigated; it is therefore very frequent, if not universal.

The amylaceous formation which is clearly defined by the two preceding examples, recurs with the same characters in the immense majority of the Florideæ and Corallineæ, as is proved by observations which I have already extended to more than thirty species belonging to twenty-five genera. The differences relate to the mode of distribution of the globules in the tissues, and the form and dimensions of the granules, which I have not as yet found superior to those of *Halopithys*, and which are sometimes scarcely 0·001 millim. I cannot enter here into the details of these observations; but they explain why certain large species, such as *Iridæa edulis*, Bory, which are very rich in this sort of starch, may furnish a nutritive food to the poor inhabitants of our coasts; and at the same time they demonstrate in most of the Florideæ and Corallineæ an abundance of amylaceous matter which may be compared with that of the potato or the cereals.

In the cellular Cryptogamia, starch in grains rendered blue by iodine accompanies chlorophyll; and its production appears to be correlative with the mode of life, which results from the functions of the green matter; where the latter is wanting no starch is found. The preceding observations acquire a fresh interest by showing, in a vast group of cellular plants deprived of chlorophyll and consequently endowed with an exclusively comburant respiration, the formation of a principle very nearly related to ordinary starch, but apparently not identical with it.

Do these globules fill the vegetative cells at all periods of the year? and what is their part in the mode of life of these plants, of which so little is yet known? These are questions which I shall endeavour to solve as soon as circumstances will permit. M. Decaisne has been kind enough to verify the principal results of this investigation, and I beg him to accept my best thanks for having done so.